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Research Article

Variability, correlation and path analyse in segregating population of groundnut (*Arachis hypogaeae* L.)

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Abstract
Two crosses in F_3 generation were studied for their variability, correlation and path analysis. The cross VRI 8 × K6 had better mean performance in all traits with very good pod and kernel yield per plant with mean of 36.59 g and 22.56 g, respectively compared to that of BSR 2 × K 6 with mean pod and kernel yield per plant of 24.95 g and 15.59 g, respectively. The cross also had high heritability of pod yield (79.45 %) and kernel yield (82.83 %) with low and moderate GAM for pod (8.87 %) and kernel yield (10.19 %), respectively. Though the crosses were in early generations, the PCV and GCV values were low to moderate for both crosses expect for the kernel yield (27.70 % & 26.71 %) in BSR 2 × K 6 and pod yield in both the crosses (23.67 % & 21.24 % in BSR 2 × K 6 and 23.73 % & 21.16 % in VRI 8 × K 6, respectively) with higher PCV, GCV values. In correlation analysis, there was a highly significant positive correlation between kernel yield and number of matured pods, number of pods, 100 pod weight, 100 kernel weight, pod yield and shelling percentage in both the crosses. Highly significant correlation was observed between shelling percentage and days to flowering in VRI 8 × K 6. Similarly, in BSR 2 × K 6, shelling percentage and 100 kernel weight were highly significantly correlated. Path analysis revealed that, there was a high positive direct effect on kernel yield by 100 kernel weight and pod yield in both the crosses. Shelling percentage in VRI 8 × K 6 had a negligible positive direct effect on the yield. Thus, on the basis of correlation and path analysis, 100 kernel weight, number of matured pods, shelling percentage, pod yield per plant were proved to be the outstanding characters influencing kernel yield in groundnut and need to be given importance in selection to achieve higher kernel yield.

Keywords: Groundnut, Segregating population, Variability, Correlation, Path Analysis

INTRODUCTION

Groundnut (*Arachis hypogaea*) is an important oilseed crop across the globe. It is been traditionally used since the origin of humanity. It is rich in oil and protein and has high energy value and plays an important role as both oil and food crop. There is a significant progress made in groundnut genetics, genomics and breeding, contributing to increased productivity and production of groundnut globally. There are large number of groundnut lines identified or developed worldwide as the source of variability for important traits and many varieties are released by such breeding programmes.

Pod yield is the important trait in which most of the breeding programme focusses on. But it is a quantitative trait and governed by many genes and influenced by the environment. So, selection in such cases becomes ineffective. Variability is the main factor which must be assessed to fix the flow of breeding programme. Apart from that, the phenotypic and genotypic relation of yield and its components are to be analysed for better progress in breeding programme. Since, most of the characters are also interrelated, each character's influence either directly or indirectly on the character of importance must also be studied. Therefore, in the breeding programme coefficient of variation, heritability and genetic advance, correlation study and path coefficient analysis are the important tools in improving yield and other desirable traits. In this background, the present study was carried out on two crosses in F_3 generation of groundnut.

MATERIALS AND METHODS

The present field experiment on groundnut was conducted in the Department of Oilseeds, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore during *Kharif,* 2021 under irrigated conditions. The experiment materials consist of two crosses *viz.,* VRI 8 × K 6, BSR 2 × K 6 in F_3 generation. The plants were raised in 20 rows and the data were recorded for every plant on single plant basis. In the cross VRI 8 × K 6 167 plants and in BSR 2 × K 6 128 plants were studied. The morphological traits recorded are days to flowering, height of main axis, number of branches, number of matured pods, number of immature pods, percentage of matured pods number of pods, pod yield per plant, kernel yield per plant, hundred pod weight, hundred kernel weight and shelling percentage.

The data were subjected to different statistical analysis *viz*., Phenotypic Coefficient of Variation and Genotypic Coefficient of Variation, heritability and genetic advance (Johnson *et. al*, 1955), correlation (Al-Jibouri *et al*., 1958) and path coefficient analysis (Dewey and Lu, 1959) using TNAUSTAT.

RESULTS AND DISCUSSION

The mean, range, PCV, GCV, heritability and genetic advance values of the two crosses in F_3 generation are presented in **Table 1.** Among the crosses, BSR 2 × K 6, had a shorter flowering period with a range of 38 - 44 days. Both the crosses had almost equal mean height of the axis of 27.47 cm for BSR 2 × K 6 and 26.38 cm for VRI 8 × K 6, respectively. But VRI 8 × K6 had a significant wider range of height between 14 - 36 cm. BSR 2×K 6 had significantly a greater number of branches with a maximum of 10 branches. Both mature and immature pods mean were higher in BSR 2 × K 6 (27.56 & 7.11). The cross BSR 2×K 6 (34.67) had significantly higher number of pods than VRI 8 × K 6 (28.16). The cross VRI 8 × K 6 had higher mean yield of pod and kernel per plant with mean of 36.59 g and 22.56 g, respectively compared to that of BSR 2 × K 6 with mean pod and kernel yield of 24.95 g and 15.59 g, respectively. It also had higher mean weight of 100 pod and kernels (159.51g & 60.79 g). Both the crosses had almost equal mean of shelling percentage (62.52% for BSR 2× K 6 and 62.49% for VRI 8 × K 6). VRI 8 × K 6 had the maximum shelling percentage of 83.33 per cent and BSR 2×K 6 with maximum of 80.77 per cent.

The PCV and GCV values were lower for both the crosses for flowering period (3.46 & 3.39 for BSR 2 × K 6 and 3.39 & 2.19 for VRI 8 × K 6). Moderate PCV and GCV for number of branches in BSR 2×K 6 (17.27 & 12.37) was observed as reported by Shoba *et al.* (2009) in groundnut. The number of mature pods had moderate PCV and GCV in BSR 2×K 6 (15.11 & 14.21). For number of pods per plant, both VRI 8 × K6 and BSR 2×K 6 had moderate PCV and GCV (14.55 & 14.02 for BSR 2 × K 6 and 19.87 & 14.65 for VRI 8 × K 6). The number of immature pods per plant had high PCV and GCV for both the crosses, similar to the study of Prabhu *et al.* (2014) in groundnut.

Table1. Estimates of variability parameters in two crosses of Groundnut in F_3 generation

Parameter	Cross	DF	HM	NB	NMP	IMP	NP	PMP	PY	KY	100 PW	100 KW	SP
Mean	C1	40.88	27.47	6.95	27.56	7.11	34.67	79.67	24.95	15.59	91.01	39.75	62.52
	C2	42.32	26.38	4.52	23.45	4.71	28.16	83.57	36.59	22.56	159.51	60.79	62.49
Range	C1	38-44	20-33	4-10	20-37	2-13	24-47	64.52-94.87	10-43	6-25	38.46-168.18	15.79-62.16	36.67-80.77
	C2	40-45	14-36	3-6	12-34	0-10	15-40	62.5-100	19-62	12-34	82.5-333.4	37.5-104.35	35.42-83.33
PCV (%)	C1	3.46	11.60	17.27	15.11	36.10	14.55	7.81	21.24	26.71	10.37	23.96	14.15
	C2	3.39	17.43	14.12	19.89	47.80	19.87	8.22	23.73	19.43	28.11	21.58	14.24
GCV (%)	C1	3.19	9.87	12.37	14.21	35.27	14.02	7.48	21.24	26.71	10.37	23.96	14.15
	C2	2.19	14.60	10.08	12.02	40.11	14.65	5.60	21.16	17.68	24.58	14.55	13.90
H^2 (%)	C1	85.00	72.43	51.32	88.47	95.45	92.92	91.56	80.50	93.03	24.13	86.04	90.35
	C2	41.78	70.20	50.94	36.53	70.43	54.34	46.30	79.45	82.83	76.44	45.44	95.32
GAM	C1	3.17	7.03	13.92	7.86	20.47	6.39	3.18	10.73	13.12	2.23	8.77	5.06
	C2	2.13	8.69	15.52	6.19	34.07	7.73	2.56	8.87	10.19	4.61	4.61	4.35

C1- BSR 2 × K 6**, C2-** VRI 8 × K6

DF- Days to flowering, HM- Height of main axis (cm), NB- Number of branches, NMP- Number of matured pods, IMP- Number of immature pods, NP- Number of pods, PMP- Percentage of matured pods, PY- Pod yield (g), KY- Kernel yield (g), 100 PW- 100 pod weight (g), 100 KW- 100 kernel weight (g), SP- Shelling percentage

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Moderate PCV and GCV for the kernel yield was observed in VRI 8 × K6 (19.43 & 17.68), whereas in BSR 2 × K 6, high PCV, GCV (27.70 & 26.71) was observed. Shelling percentage had moderate PCV, GCV in both VRI 8 × K6 and BSR 2×K 6 (Nandini *et al.,* 2018) in groundnut.

BSR 2 × K 6 had higher heritability (85 %) and VRI 8 × K6 (41.78 %) with moderate heritability for flowering period. Both the crosses exhibited higher heritability and low GA for height of main axis (72.43 % & 7.03 % for BSR 2 × K 6 and 70.20 % & 8.69 % for VRI 8 × K 6). Moderate heritability and moderate GAM were observed in both the crosses for number of branches. Heritability of mature and immature pods were higher for both the crosses. High heritability with high GAM was observed in both the crosses for number of immature pods. Number of pods per plant had higher heritability and lower GAM for both the crosses. High heritability of pod (80.50 % & 79.45 % for BSR 2 × K 6 and VRI 8 × K 6, respectively) and kernel yield (93.03 % for BSR 2 × K 6 and 82.83 % for VRI 8 × K 6) was observed for both the crosses. Kernel yield had moderate level of genetic advance for both the crosses (13.12 % & 10.19 % for BSR 2 × K 6 and VRI 8 × K 6, respectively). 100 pod weight had lower heritability in BSR 2 × K 6 (24.13 %) and higher heritability in VRI 8 × K 6 (76.44 %). 100 kernel weight had moderate heritability for VRI 8 × K 6 (45.44 %) and higher heritability for BSR 2 × K 6 (86.04 %). GAM was low for both the crosses for both the characters. Similar data in groundnut were observed by John *et al.* (2013) in their study. Shelling percentage had high heritability (90.35 % & 95.32 % for BSR 2 × K 6 and VRI 8 × K 6, respectively), as reported earlier by Aditya Veer and Vikas Kumar (2021) in groundnut and lower GA for both the crosses (5.06 % & 4.35 % for BSR 2 × K 6 and VRI 8 × K 6, respectively).

As mean performance is the important criteria in breeding programme, in the present study based on mean performance, the cross VRI 8 × K6 ha better mean performance for all traits with very good pod and kernel

Table 2. Correlation analysis for yield and yield related traits in two crosses of groundnut in F_3 generation

Character	Cross	DF	HM	NB	NMP	IMP	NP	PMP	100 PW	100 KW	SP	PY	KY
DF	C1	1											
	C2	1											
HM	C1	-0.0166	1										
	C2	0.0419	1										
NB	C1	0.1631	-0.123	1									
	C2	0.0123	-0.0944	1									
NMP	C1	0.0067	0.1882*	-0.0632	1								
	C2	0.1728*	0.0076	0.0293	1								
IMP	C1	0.2229*	-0.1007	0.1017	0.0710	1							
	C2	-0.0192	0.0082	0.0188	0.2123**	1							
NP	C1	0.119	0.1042	-0.0004	0.8616**	0.5667**	1						
	C2	0.1363	0.0096	0.032	0.9193**	0.5798**	1						
PMP	C1	-0.2103*	0.1736	-01326	0.3252**	-0.9133**	-0.1962*	1					
	C2	0.1194	-0.0136	-0.0039	0.1741*	-0.9068**	-0.22**	1					
100 PW	C1	0.0928	0.554	0.1117	-0.1649	0.0031	-0.1346	-0.0746	1				
	C2	-0.2771	-0.0455	-0.0548	-0.5251**	-0.0967	-0.4768**	-0.1129	1				
100KW	C1	0.0315	0.1114	0.1616	-0.03	0.0197	-0.0147	-0.0278	0.7913**	1			
	C2	-0.1368	-0.0658	-0.0303	-0.398**	-0.1224	-0.3812**	-0.0373	0.8054**	1			
SP	C1	-0.0702	0.0681	0.1188	-0.1374	-0.0121	-0.1196	-0.0332	0.072	0.6311**	1		
	C2	0.2383**	-0.0364	0.0681	-0.0558	-0.095	-0.0848	0.0693	-0.4423**	0.0948	1		
PY	C1	0.0643	0.1781*	0.0619	0.4956**	0.0518	0.4357**	0.1407	0.7633**	0.6803**	-.0123	1	
	C2	-0.1852*	-0.0272	-0.0505	0.2751**	0.0896	0.2655**	0.016	0,6424**	0.547**	-0.5723**	1	
KY	C1	0.0135	0.177	0.134	0.3485**	0.0502	0.3134**	0.0918	0.6688**	0.9217**	0.5439**	0.826**	1
	C2	-0.0294	-0.0618	-0.0228	0.306**	0.0304	0.2674**	0.0846	0.4397**	0.7403**	0.0518	0.7802**	1

*Significant at 5% level ** Significant at 1% level
C1- BSR 2 × K 6, C2- VRI 8 × K6
DF- Days to flowering, HM- Height of main axis , NB- Number of branches, NMP- Number of matured pods, NIMP- Number of immature pods, NP- Number of pods, M%- Percentage of matured pods, PY- Pod yield, KY- Kernel yield, 100PW- 100 pod weight, 100KW- 100 kernel weight, SP- Shelling percentage

yield. The cross also had high heritability of pod yield and moderate heritability of kernel yield with low genetic advance. Though the crosses were in early generations, the PCV and GCV values were low to moderate for both crosses expect for the kernel yield and pod yield with higher PCV and GCV values. With these findings, it is concluded that the cross VRI 8 × K6 is better in terms of yield and can be utilized for further advancement.

The association studies contribute to a greater extent in breeding programmes in Selection and to understand the relationship between different traits and their contributions towards the yield. The correlation analysis of the two crosses in F_3 generation are presented in **Table 2**. There was a highly significant positive correlation between kernel yield and number of matured pods, number of pods, 100 pod weight, 100 kernel weight, pod yield and shelling percentage in both the crosses. Dandu *et al.* (2012), Nandini and Savithramma (2012), Prabhu *et al.* (2014) reported similar results in their studies in groundnut.

There was a highly significant positive correlation between number of mature pods and days to flowering in VRI 8 × K6 and number of immature pods and days to flowering in BSR 2 × K 6. Pod yield and height of main axis were also significantly correlated in BSR 2 × K 6. Similar correlation was also reported by Sardar *et al.* (2017). Highly significant correlation was observed between shelling percentage and days to flowering in VRI 8 × K6, which were reported earlier by Shoba *et al.* (2012) and Prabhu *et al*. (2015). Similarly, in BSR 2 × K 6, shelling percentage and 100 kernel weight were found to be highly significantly correlated which were earlier reported by Babariya and Dobariya (2012) in groundnut. Significant negative correlation was observed between percentage of mature pods and days to flowering, number of pods and number of immature pods in BSR 2 × K 6. In VRI 8 × K6, pod yield and days to flowering, number of pods and 100 kernel weight, shelling percentage and 100 pod weight, pod yield and shelling percentage were negatively correlated.

Table 3. Path coefficient analysis for yield and yield related traits in two crosses of groundnut in F_3 generation

Character		DF	HM	NB	NMP	IMP	NP	PMP	100 PW	100 KW	SP	PY	Correlation with kernel yield
DF	C1	**-0.0165**	0	0.0009	0.0083	0.2375	-0.316	0.0053	-.04	0.0271	-0.003	0.0356	0.0135
	C2	**-0.0115**	-0.0004	-0.0001	0.0034	-0.0001	0.0239	-0.0011	0.133	-0.1222	0.0254	-0.195	-0.0294
HM	C1	0.0003	**-0.0014**	-0.007	0.2329	-0.1072	-0.2768	-0.0044	-0.0239	0.0957	0.0029	0.0987	0.177
	C2	-0.0005	**-0.0085**	0.0007	0.0001	0.0001	0.0017	0.001	0.0218	-0.0588	-0.0039	-0.0161	-0.0618
NB	C1	-0.0027	0.0002	**0.0058**	-0.0782	0.1084	0.001	0.0033	-0.0482	0.1389	0.005	0.0343	0.134
	C2	-0.0001	0.0008	**-0.0071**	0.0006	0.0001	0.0056	0	0.0263	-0.027	0.0073	-0.0299	-0.0228
NMP	C1	-0.0001	-0.0003	-0.0004	**1.2376**	0.0746	-2.2891	-0.0082	0.0711	-0.0258	-0.0058	0.2745	0.3485**
	C2	-0.002	-0.0001	-0.0002	**0.0195**	0.0015	0.1609	-0.0016	0.2521	-0.3555	-0.006	0.1627	0.306**
IMP	C1	-0.0037	0.0001	0.0006	0.0867	**1.0653**	-1.5057	0.023	-0.0013	0.0169	-0.005	0.0287	0.0502
	C2	0.0002	-0.0001	-0.0001	0.0041	**0.007**	0.1014	0.0085	0.0464	-0.1094	-0.0101	0.053	0.0304
NP	C1	-0.002	-.0.001	0	1.0663	0.6038	**-2.6568**	0.0049	0.058	-0.0127	-0.0051	0.2413	0.3134**
	C2	-0.0016	-0.0001	-0.0002	0.0179	0.0041	**0.175**	0.0021	0.2289	-0.3405	-0.009	0.157	0.2674**
PMP	C1	0.0035	-0.0002	-0.0008	0.4024	-0.973	0.5213	**-0.0252**	0.0321	-0.0239	-0.0014	0.0779	0.0918
	C2	-0.0014	0.0001	0	0.0034	-0.0064	-0.0385	**-0.0094**	0.0542	-0.0333	0.0074	0.0094	0.0846
100 PW	C1	-0.0015	-0.0001	0.0007	-0.204	0.0033	0.3576	0.0019	**-0.4311**	0.6802	0.003	0.4228	0.6688**
	C2	0.0032	0.0004	0.0004	-0.0101	-0.0007	-0.0834	0.0011	**-0.48**	0.7195	-0.0472	0.3799	0.4397**
100KW	C1	-0.0005	-0.0002	0.0009	-0.0371	0.021	0.0392	0.0007	-0.3411	**0.8596**	0.0267	0.3768	0.9217**
	C2	0.0016	0.0006	0.0002	-0.0078	-0.0009	-0.0667	0.0003	-0.3866	**0.8933**	0.0101	0.3235	0.7403**
SP	C1	0.0012	-0.0001	0.0007	-0.17	-0.0129	0.3178	0.0008	-0.031	0.5425	**0.0424**	-.0068	0.5439**
	C2	-0.0027	0.0003	-0.0005	-0.001	-0.0007	-0.0148	-0.0006	0.2123	0.0847	**0.1067**	-0.3384	0.0518
PY	C1	-0.001	-0.0003	0.0004	0.6134	0.0552	-1.1575	-0.0035	-0.3291	0.5848	-0.0005	**0.5539**	0.826**
	C2	0.0021	0.0002	0.0004	0.0054	0.0006	0.0465	-0.0001	-0.3284	0.4887	-0.0611	**0.5913**	0.7802**

Residual effect: C1: 06042; C2: 01742

C1- BSR 2 × K 6, C2- VRI 8 × K6

DF- Days to flowering, HM- Height of main axis, NB- Number of branches, NMP- Number of matured pods, IMP- Number of immature pods, NP- Number of pods, PMP- Percentage of mature pods, PY- Pod yield, KY- Kernel yield, 100 PW- 100 pod weight, 100 KW- 100 kernel weight ,SP- Shelling percentage

The path analysis for the two crosses in F_3 generation are presented in **Table 3**. In case of VRI 8 × K 6, there was a high positive direct effect on kernel yield by 100 kernel weight and pod yield which were similar to the observations of Sumathi and Muralitharan (2007) and Shoba *et al*. (2012) in groundnut. Positive low direct effect on yield was contributed by shelling percentage. Positive low indirect effect was contributed towards yield from days to flowering through 100 pod weight and positive high indirect effect was contributed by 100 pod weight, 100 kernel weight through pod yield. Height of main axis and 100 pod weight showed high negative direct effect on kernel yield.

In BSR 2 × K 6, positive high direct effect on kernel yield by 100 kernel weight, pod yield, number of mature and immature pods were observed. Shoba *et al.* (2012) and Hampannavar *et al*. (2018) reported similar results in groundnut. Number of pods and percentage of mature pods had high indirect effect on number of mature pods contributing to kernel yield, similar to findings of Patil *et al*. (2015). Height of main axis had moderate indirect effect on kernel yield through number of mature pods, which were earlier reported by Pachauri *et al.* (2022). Negative high direct effect was caused by number of pods and 100 pod weight. Reddy *et al.* (2017) reported that days to flowering had high indirect negative effect on yield through number of pods, which was observed in the present study.

Thus, on the basis of correlations and path analysis shelling percentage (Prabhu *et al.,* 2017), number of mature pods, 100 kernel weight and pod yield per plant (Shoba *et al*., 2012) were proved to be the outstanding characters influencing kernel yield in groundnut and need to be given importance in selection to achieve higher kernel yield.

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